



12/22/99

(2-27-99)

Docket No. 25141-0430

In re Application of W. Cornish et al.

Serial No.: To be assigned

Filed: December 22, 1999

For: COMPOSITE GUIDEWIRE WITH DRAWN AND  
FILLED TUBE CONSTRUCTION

NEW APPLICATION TRANSMITTAL

Express Mail No. EL294132975US

The Assistant Commissioner for Patents

Box Patent Application

Washington, D.C. 20231

SIR:

1. Transmitted herewith for filing is the above-identified patent application  
 2. Enclosed are:

- the papers required for a filing date under 37 CFR §1.53(b)  
 25 pages of specification including claims and abstract  
 2 sheets of drawings  informal  formal.  
 Declaration and Power of Attorney (unsigned)  
 Assignment with Transmittal (PTO-1595)  
 Other Specify: Information Disclosure Statement w/PTO-1449, together with copies of cited references and return receipt postcard

JC6584 U.S. PTO  
09/470874  
12/22/99

- Applicant is a small entity entitled to a 50% reduction in fees

Verified statement enclosed

Filing Fee Calculations

	Number Filed	Number Extra	Rate	Basic Fee
Total Claims	25 - 20 =	0	5 \$18 =	\$90-
Independent Claims	2 - 3 =	0	x \$78 =	\$-0-
Multiple dependent claims if any			x \$260 =	\$850-

\* If less than zero, enter "0".

Total Filing Fee ..... \$850

5. Additional Fees

Assignment	.....	\$-0-
Other Specify	.....	\$850
Total Fees Due	.....	<u>\$850</u>

Fee Payment

Payment of filing fee deferred

Attached is a check in the amount of \$850 (Filing Fee)

Charge Deposit Account No. 08-1641 in the amount of \$ ..... A duplicate of this request is attached.

The Commissioner is hereby authorized to charge any additional fees which may be required or credit any overpayment to Deposit Account No. 08-1641, referencing Docket No. 25141-0430. A duplicate of this request is attached.

By:

*Soodabeh Tronson*  
Soodabeh Tronson  
Registration No. 41,354

APPLICATION

of

Marc Mehrzad Jalisi

David M. Anderson

Wayne E. Cornish

Nancy A. Nicotra

and

Mark T. Richardson

for

UNITED STATES LETTERS PATENT

on

**COMPOSITE GUIDEWIRE WITH DRAWN AND FILLED TUBE CONSTRUCTION**

Sheets of Drawings: Two (2)  
Atty. Docket No.: 25141-0430  
Client Ref. No.: 1700

Heller Ehrman White & McAuliffe  
525 University Avenue  
Palo Alto, CA 94301-1900  
(650) 324-7000

Docket No. 25141-0430

## **COMPOSITE GUIDEWIRE WITH DRAWN AND ILLED TUBE CONSTRUCTION**

### **RELATED APPLICATIONS**

This application is a continuation in part of US Patent Application,  
5 Serial number 09/224,453 by M. Jalisi et al, entitled "Guidewire Having  
Braided Wire Over Drawn Tube Construction", filed on December 31, 1998,  
and assigned to the assignee of the present invention, incorporated herein by  
reference in its entirely.

### **FIELD OF INVENTION**

10 This invention relates to the field of guidewires for advancing  
intraluminal devices such as stent delivery catheters, balloon dilatation  
catheters, atherectomy catheters and the like within body lumens.

### **BACKGROUND OF THE INVENTION**

Conventional guidewires for angioplasty and other vascular procedures  
15 usually comprise an elongated core member with one or more tapered  
sections near the distal end thereof and a flexible body such as a helical coil  
disposed about the distal portion of the core member. A shapeable member,  
which may be the distal extremity of the core member or a separate shaping

ribbon which is secured to the distal extremity of the core member extends through the flexible body and is secured to a rounded tip at the distal end of the flexible body.

In a typical coronary procedure, a guiding catheter having a preformed 5 distal tip is percutaneously introduced into a patient's peripheral artery, e.g. femoral or brachial artery, by means of a conventional Seldinger technique and advanced therein until the distal tip of the guiding catheter is seated in the ostium of a desired coronary artery. A guidewire is positioned within an inner lumen of a dilatation catheter and then both are advanced through the 10 guiding catheter to the distal end thereof. The guidewire is first advanced out of the distal end of the guiding catheter into the patient's coronary vasculature until the distal end of the guidewire crosses a lesion to be dilated, then the dilatation catheter having an inflatable balloon on the distal portion thereof is advanced into the patient's coronary anatomy over the 15 previously introduced guidewire until the balloon of the dilatation catheter is properly positioned across the lesion. Once in position across the lesion, the procedure is performed.

A requirement for guidewires is that they have sufficient column strength to be pushed through a patient's vascular system or other body

lumen without kinking. However, guidewires must also be flexible enough to avoid damaging the blood vessel or other body lumen through which they are advanced. Efforts have been made to improve both the strength and flexibility of guidewires to make them more suitable for their intended uses,  
5 but these two properties are for the most part, diametrically opposed to one another in that an increase in one usually involves a decrease in the other.

Further details of guidewires, and devices associated therewith for various interventional procedures can be found in U.S. Patent 4,748,986 (Morrison et al.); U.S. Patent 4,538,622 (Samson et al.); U.S. Patent 10 5,135,503 (Abrams); U.S. Patent 5,341,818 (Abrams et al.); and U.S. Patent 5,345,945 (Hodgson et al.); all of which are incorporated herein in their entirety by reference.

Some guidewires have been formed from a superelastic alloy such as a NITINOL (nickel-titanium or NiTi) alloy, to achieve both flexibility and strength. When stress is applied to NITINOL alloy exhibiting superelastic characteristics at a temperature at or above which the transformation of martensite phase to the austenite phase is complete, the specimen deforms elastically until it reaches a particular stress level where the alloy then undergoes a stress-induced phase transformation from the austenite phase to

the martensite phase. As the phase transformation proceeds, the alloy undergoes significant increases in strain but with little or no corresponding increases in stress. The strain increases while the stress remains essentially constant until the transformation of the austenite phase to the martensite  
5 phase is complete. Thereafter, further increase in stress are necessary to cause further deformation.

If the load on the specimen is removed before any permanent deformation has occurred, the martensitic phase of the specimen will elastically recover and transform back to the austenite phase. The reduction in stress first causes a decrease in strain. As stress reduction reaches the level at which the martensite phase transforms back into the austenite phase, the stress level in the specimen will remain essentially constant until the transformation back to the austenite phase is complete, i.e. there is significant recovery in strain with only negligible corresponding stress  
10 reduction. After the transformation back to austenite is complete, further stress reduction results in elastic strain reduction. This ability to incur significant strain at relatively constant stress upon the application of a load and to recover from the deformation upon the removal of the load is commonly referred to as superelasticity. These properties to a large degree  
15

allow a guidewire core of a superelastic material to have both flexibility and strength.

While the properties of the guidewire formed of the superelastic material were very advantageous, it was found that the guidewires and  
5 guiding members formed of materials having superelastic characteristics did not have optimum push and torque characteristics.

### SUMMARY OF THE INVENTION

The present invention is directed to an intracorporeal device, preferably a guidewire, and method for making the device. The guidewire of the present invention is formed, at least in part, of a composite elongate core member formed, at least in part, of precipitation hardened material. The elongate core members of the present invention will have an ultimate tensile strength and modulus of elasticity greater than the same for an identically dimensioned elongate member formed from superelastic NITINOL alone.  
10

15 Preferably, the composite elongate core member has a modulus of elasticity of at least  $9 \times 10^6$  psi, more preferably, at least  $12 \times 10^6$  psi, and most preferably, at least  $15 \times 10^6$  psi.

Preferably, the composite elongate core member has a an ultimate tensile strength of at least 150 ksi, more preferably, at least 180 ksi, and most preferably, at least 200 ksi.

In one embodiment, the precipitation hardened material is formed from  
5 a material comprising at least two material selected from the group consisting of nickel, cobalt, molybdenum, chromium, tungsten, and iron.

In one embodiment, the precipitation hardened material is formed from a precipitation hardenable stainless steel. Preferably, the precipitation hardenable stainless steel is chromium-nickel based single stage martensitic precipitation hardenable stainless steel. In another embodiment, the precipitation hardenable stainless steel is essentially nickel free.

In another embodiment, the precipitation hardened material is formed from a cobalt based alloy. In one embodiment the cobalt based alloy further includes nickel, molybdenum and chromium while in another embodiment it further includes less than about 10 % by wt. iron.  
15

In one preferred embodiment, the composite elongate core member has an inner core element and a first layer portion disposed at least in part about the inner core element, the inner core element and the first layer portion being formed of different material. In an embodiment, the inner core element

and the first layer portion are independently formed from superelastic NITINOL and precipitation hardenable material. In another embodiment, the composite elongate core member further includes a second layer portion disposed at least in part about the first layer portion and formed of a material  
5 similar to the inner core element material.

In a preferred embodiment, the composite elongate core member includes a distal segment having a distally tapered section with proximal and distal portions, and a distal flexible section, the inner core element being at least partially exposed at the distal flexible section of the distal segment of  
10 the composite elongate member.

As is known in the art, many materials used for guidewire construction have desirable mechanical properties, but are difficult to assemble to other guidewire components using conventional technology such as soldering or use of polymer adhesives due to inherent surface properties such as  
15 tenacious oxide layers. The construction of guidewires according to the present invention allows the use of materials which have poor bondability or solderability.

The present invention allows for the design of a guidewire with a unitary core, rather than a core with proximal and distal segments joined

together. Additionally, the core members of the present invention may be used with other wire designs to create guidewires with improved superelasticity and kink-resistance.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

5 FIG. 1 is a longitudinal cross sectional view of a guidewire embodying features of the invention.

FIG. 2 is a transverse cross sectional view of the guidewire of FIG. 1 taken along line 2-2.

10 FIG. 3 is a transverse cross sectional view of the guidewire of FIG. 1 taken along line 3-3.

FIG. 4 is a diagrammatic illustration of a stress-strain curve.

FIG. 5 is a transverse cross sectional view of an alternative guidewire embodying another configuration.

15 FIG. 6 is a transverse cross sectional view of another alternative

guidewire embodying another configuration.

#### **DETAILED DESCRIPTION OF THE INVENTION**

Figs. 1, 2 and 3 illustrate features of a guidewire 10 embodying the present invention. A composite elongate core member 11 has a distal

segment 13 having a distally tapered section 16 with a proximal portion 19, a distal portion 22, and a distal flexible section 25 at a distal end 28 of the guidewire 10 for negotiating the guidewire 10 through the patient's vasculature without causing injury thereto. The distally tapered section 16 can be adjusted in length, taper angle and cross sectional shape to achieve the desired flexibility and performance characteristics for the guidewire 10.

The elongate core member 11 has an inner core element 31 formed from a precipitation hardenable material, a first layer portion 37 formed from a superelastic material disposed on an outer surface 43 of the inner core element 31, and a second layer portion 46 formed from precipitation hardenable material disposed on an outer surface 52 of the first layer portion 37. The inner core element 31 is at least partially exposed at the distal flexible section 25 of the distal segment 13 of the composite elongate member 11. The inner core element 31 may also be exposed at a distal end 53 of the distal portion 22. The first layer portion 37 is at least partially exposed at the distal portion 22 of the distally tapered section 16 of the distal segment 13 of the composite elongate core member 11.

In FIG. 1, The first layer portion 37 and second layer portion 46 are shown as smooth continuous layers. The inner core element 31 has a

proximal section 55, a distal section 58 and a distal end 61. The first layer portion 37 has a distal section 64 and a proximal section 67. The second layer portion 46 has a distal section 70 and a proximal section 73.

The distal end 61 of the inner core element 31 is secured to a distal end 76 of a flexible body 79 by a first body of solder 82. A proximal end 85 of the flexible body 79 is secured to the distal section 70 of the second layer portion 46 with a second body of solder 88. Although a single distally tapered section 16 is shown, the distal segment 13 of the elongate core member 11 may have two or more such tapered segments which may or may not be separated by segments of substantially constant diameter. The flexible body 79 is disposed partially about the distally tapered section 16 of the distal segment 13 of the elongate core member 11. The distal flexible section 25 is shown as a flattened portion of the exposed inner core element 31, however, the distal flexible section 25 can have a round cross section, or any other suitable configuration.

The flexible body 79 may be any flexible material such as a helical coil or, a polymer jacket, or the like. Polymers suitable for forming the flexible body 79 include, but are not limited to, polyimide, polyethylene, polyurethane, tetrafluoroethylene (TFE), polytetrafluoroethylene (PTFE),

expanded polytetrafluoroethylene (PTFE), and other similar materials. The flexible body 79 in the form of a helical coil 92 (as shown in FIG. 1) may be formed of a suitable radiopaque material such as tantalum, gold, iridium, platinum or alloys thereof or formed of other material such as stainless steel and coated with a radiopaque material such as gold. The wire from which the coil 92 is made generally has a transverse diameter of about 0.001 to about 0.004 inch, preferably about 0.002 to about 0.003 inch. Multiple turns of a distal portion of coil 92 may be expanded to provide additional flexibility. The flexible body 79 may have transverse dimensions about the same as a proximal section 95 of the elongate core member 11. The flexible body 79 may have a length of about 2 to about 40 cm or more, but typically will have a length of about 2 to about 10 cm.

The inner core element 31, at an untapered region such as the proximal section 95 of the elongate core member 11, has a nominal transverse dimension of up to about 0.010 inches, preferably, about 0.003 to about 0.01 inches, and more preferably, about 0.003 to about 0.006 inches. The first layer portion 37 and second layer portion 46, at an untapered region such as the proximal section 95 of the elongate core member 11, each have a nominal wall thickness of up to about 0.015

inches, preferably, about 0.0005 to about 0.01 inches, and more preferably, about 0.001 to about 0.003 inches. Although the inner core element 31 is shown as solid, the inner core element 31 may also be hollow with a lumen extending longitudinally therethrough (not shown) for delivery of diagnostic or therapeutic agents, such as radioactive therapy agents or angiogenic growth factors or the like; or for advancement of elongated medical devices into a patient's vasculature.

The inner core element 31 and the second layer portion 46 may both be formed of precipitation hardened material formed from precipitation hardenable material, with the first layer portion 37 being formed from a superelastic material such as superelastic NITINOL. However, as discussed below, other configurations may also be employed in the practice of the invention.

A significant aspect of the invention resides in forming the composite elongate core member 11, at least in part, from precipitation hardenable material so that the ultimate tensile strength ( $\sigma_{uts}$ ) and tensile yield strength ( $\sigma_{ys}$ ) of the composite (FIG. 4) are raised to enhance the elastic strength and operability of the guidewire, as compared to an elongate core member formed of superelastic NiTi alone.

In an embodiment, features of which are illustrated in FIG. 5 and wherein like references refer to like parts, the guidewire 10' has an inner core element 31' formed from precipitation hardenable material (e.g., precipitation hardenable stainless steel) and a first layer portion 37' formed from superelastic material (e.g., superelastic NITINOL).

In another embodiment, features of which are illustrated in FIG. 6 and wherein like references refer to like parts, the guidewire 10" has an inner core element 31" formed from superelastic material (e.g., NITINOL) and a first layer portion 37" formed from precipitation hardenable material (e.g., precipitation hardenable stainless steel).

Materials suitable for use in the practice of the invention are characterized in that they are precipitation hardenable by controlled heat treatment, not only to increase the ultimate tensile strength of the material but also to increase the tensile yield strength.

The characteristics of the composite elongate core member 11 according to the present invention, without any intention to limit the scope of the invention, may be described as follows:

The ultimate tensile strength and the Young modulus of elasticity for the composite elongated core member are proportional to the cross sectional

area of each constituent multiplied by the ultimate tensile strength or the modulus of elasticity, respectively, of that constituent, as defined in Equations I and II, respectively:

$$\sigma_{uts(C)} = [\sigma_{uts(S)} \times (A_{(S)} / A_{(C)})] + [\sigma_{uts(Co)} \times (A_{(Co)} / A_{(C)})] \quad \text{Equation I}$$

$$E_{(C)} = [E_{(S)} \times (A_{(S)} / A_{(C)})] + [E_{(Co)} \times (A_{(Co)} / A_{(C)})] \quad \text{Equation II}$$

wherein

$\sigma_{uts}$  is the ultimate tensile strength,

E is the Young modulus of elasticity

A is the cross sectional area,

C is the composite member,

Co is the core,

S is the shell (the shell may, itself, comprise various layers, such as the first and second layer portions).

The foregoing characteristics may be achieved by making the

composite elongate core member 11, in part, from a precipitation hardenable material. Examples of such precipitation hardenable materials include, but are not limited to, AISI (American Iron and Steel Institute) Type 600 series precipitation hardenable stainless steel. Additional examples include chromium-nickel based single stage martensitic precipitation hardenable

stainless steel having modified proportions of chromium and nickel and with additional elements of copper and titanium, commercially available from Carpenter Steel Company of Reading, Pa., under the designation 455PH or 17-7PH; and a precipitation hardenable steel available under the trade

5 designation 1RK91 from Sewden Steel.

Other suitable precipitation hardenable stainless steel include those which are essentially "nickel free" such as those sold under the designation BioDur 108, available from Carpenter's Specialty Alloys Operations, Reading, Pa. By way of example, the nominal composition of BioDur is chromium (21%), manganese (23%), nitrogen (1%), nickel (less than 0.3%), and iron (balance).

Other suitable precipitation hardenable material include cobalt based alloys such as those including nickel, cobalt, molybdenum and chromium, also commercially available under the designation MP35N (UNS (Unified Numbering System) R30035) available from Carpenter Steel Co. Also useful in the practice of the invention is a similar alloy that contains a small amount of iron (less than about 10%) and is commercially available under the trade designation Elgiloy (UNS R30003) and L605 from Haynes International of Kokomo, In.

The material for forming the first layer portion 37 may be a superelastic alloy, such as superelastic NITINOL (NiTi).

By way of example, the ultimate tensile strength and Young modulus for the composite core member 11 according to Fig. 5, may be calculated  
5 using nominal and or preferred values for the ultimate tensile strength and Young modulus for each of the constituents, using Equations I and II, above, and the following parameters:

C has an overall outer diameter of 0.0125 inch,

Co is precipitation hardenable stainless steel (PHSS),

% A<sub>(Co)</sub> = 6 to 20 %, nominal 12% - equivalent to a core outer diameter of about 0.0045 inch,

S is superelastic NiTi,

% A<sub>(S)</sub> = 94 to 80 %, nominal 88%, equivalent to a shell wall thickness of about 0.004 inch (0.008 inch total shell thickness),

E<sub>(Co)</sub> = 28-30x10<sup>6</sup> psi, nominal 28.5x10<sup>6</sup> psi, for PHSS; and 33.5-35x10<sup>6</sup> psi, nominal 34.5x10<sup>6</sup> psi, for cobalt base alloys such as MP35N, L605, and Elgiloy, with less than 10% Iron,

$\sigma_{uts}$  (Co) = 250-330 ksi, preferably  $\geq$  280 ksi,

5             $E_{(S)} = 9-13 \times 10^6$  psi, nominal  $12 \times 10^6$  for NiTi,

10           $\sigma_{uts(S)} = 160-190$  ksi, preferably  $\geq 175$  ksi,

$$\sigma_{uts(C)} = [\sigma_{uts(S)} \times (A_{(S)} / A_{(C)})] + [\sigma_{uts(Co)} \times (A_{(Co)} / A_{(C)})]$$

$$\sigma_{uts(C)} = (0.88 \times 175 \text{ ksi}) + (0.12 \times 280 \text{ ksi}) = 188 \text{ ksi}$$

15           $E_{(C)} = (0.88 \times 12 \times 10^6 \text{ psi}) + (0.12 \times 28.5 \times 10^6 \text{ psi}) = 14 \times 10^6 \text{ psi}$

As can be seen from the equations and numbers above, the elongate core members of the present invention will have an ultimate tensile strength and modulus of elasticity greater than the same for an identically dimensioned elongate member formed from superelastic NITINOL alone.

The composite elongate core member 11 will preferably have an ultimate tensile strength of at least 150 ksi, more preferably, at least 180 ksi, and most preferably, at least 200 ksi; and a modulus of elasticity greater than  $9 \times 10^6$  psi, more preferably, greater than  $12 \times 10^6$  psi, and most preferably, greater than  $15 \times 10^6$  psi.

The following process is provided, by way of example and not as limitation, to illustrate the method of forming the composite elongate core member 11 of the guidewire 10 in accordance with the invention.

A NiTi alloy tube, for forming the first layer portion 37, having a composition of about 55.9% Ni and 44.1% Ti was drawn to a diameter of about 0.060 inch and an inner diameter of about 0.024 inch. A wire of 17-7PH precipitation hardenable stainless steel was formed with a diameter of about 0.020 inch for forming the inner core element 31. The 17-7PH wire was inserted into the first layer portion 37. A tube of 17-7PH was prepared with an inner diameter of about 0.068 inch and an outer diameter of about 0.114 inch for forming the second outer layer portion 46. The 17-7PH tube for the second layer portion 46 was disposed over the first layer portion 37 (NiTi tube) containing the inner core element 31 (17-7PH wire).

The entire assembly was then drawn in a series of five stages with a 30-60% reduction in cross-sectional area followed by a heat treatment between 600-800°C, in air for about 15 minutes, at each stage. The fifth stage was followed by a sixth stage which included drawing with cold work of about 16% followed by heat treating at a temperature between 400-600°C and a seventh stage which included drawing with a cold work of about 50% but with no heat treatment. The final cold worked product was aged at a temperature of about 650°C for about one minute to develop maximum bending, yield, and modulus with minimum springback.

It should be noted that other suitable methods may also be used. For example, the inner core element 31 and the first layer portion 37, and the second layer portion 46, may have different dimensions. Alternatively, the inner core element 31 may be loaded into the first layer portion 37 and cold drawn down to a suitable size prior to insertion into the second layer portion

5  
46. The new assembly can then be drawn down to the desired final size.

While particular forms of the invention have been illustrated and described, it will be apparent that various modifications can be made without departing from the spirit and scope of the invention. Accordingly, it is not intended that the invention be limited, except as by the appended claims.

## CLAIMS

WHAT IS CLAIMED IS:

1. A heat-treated elongate member formed at least in part of a composite elongate core formed at least in part of a precipitation hardened material.
2. The elongate member of Claim 1 wherein the composite elongate core has a modulus of elasticity of at least  $9 \times 10^6$  psi.
3. The elongate member of Claim 2 wherein the modulus of elasticity is at least  $12 \times 10^6$  psi.
4. The elongate member of Claim 3 wherein the modulus of elasticity is at least  $15 \times 10^6$  psi.
5. The elongate member of Claim 1 wherein the composite elongate core has an ultimate tensile strength of at least 150 ksi.
6. The elongate member of Claim 5 wherein the ultimate tensile strength is at least 180 ksi.
7. The elongate member of Claim 6 wherein the ultimate tensile strength is at least 200 ksi.

8. A heat-treated elongate member formed at least in part of a composite  
elongate core formed of at least in part of precipitation hardened  
material formed from a precipitation hardenable material comprising of  
at least two material selected from the group consisting of nickel,  
5 cobalt, molybdenum, chromium, tungsten, and iron.
9. The elongate member of Claim 8 wherein the precipitation hardenable  
material is precipitation hardenable stainless steel.
10. The elongate member of Claim 9 wherein the precipitation hardenable  
material is chromium-nickel based single stage martensitic precipitation  
5 hardenable stainless steel.
11. The elongate member of Claim 9 wherein the precipitation hardenable  
stainless steel is essentially nickel free.
12. The elongate member of Claim 9 wherein the precipitation hardenable  
stainless steel includes less than about 1% nickel.
- 15 13. The elongate member of Claim 8 wherein the precipitation hardenable  
material is a cobalt based precipitation hardenable alloy.
14. The elongate member of Claim 13 wherein the cobalt based alloy  
further includes nickel, molybdenum and chromium.

15. The elongate member of Claim 14 wherein the alloy further includes less than about 10 % by wt. iron.
16. The elongate member of Claim 8 wherein the composite elongate core has an inner core element and a first layer portion disposed at least in part about the inner core element, the inner core element and the first layer portion being formed from different material.  
5
17. The elongate member of Claim 16 wherein the inner core element and the first layer portion are independently formed from superelastic NITINOL and precipitation hardenable material.
18. The elongate member of Claim 17 wherein the inner core element is formed from superelastic NITINOL.  
10
19. The elongate member of Claim 17 the first layer portion is formed from superelastic NITINOL.
20. The elongate member of Claim 19 wherein the composite elongate core further includes a second layer portion disposed at least in part about the first layer portion and formed from a material similar to the inner core element material.  
15

21. The elongate member of Claim 18 wherein the composite elongate core further includes a second layer portion disposed at least in part about the first layer portion and formed from a material similar to core element material.
- 5        22. The elongate member of Claim 18 wherein the elongate member is a guidewire.
23. The elongate member of Claim 22 wherein the composite elongate core includes a distal segment having a distally tapered section with proximal and distal portions, and a distal flexible section, the inner core element being at least partially exposed at the distal flexible section of the distal segment of the composite elongate member.
- 10        24. The elongate member of Claim 19 wherein the elongate member is a guidewire.
- 15        25. The elongate member of 24 wherein the composite elongate core includes a distal segment having a distally tapered section with proximal and distal portions, and a distal flexible section, the inner core element being at least partially exposed at the distal flexible section of the distal segment of the composite elongate member, and the first

layer portion being at least substantially exposed at the proximal portion of the distally tapered section of the distal segment of the composite elongate core.

5

RECEIVED  
U.S. PATENT AND TRADEMARK OFFICE  
MAY 10 2010

## ABSTRACT OF THE DISCLOSURE

The present invention is directed to an intracorporeal device, preferably a guidewire, and method for making the device. The guidewire of the present invention is formed, at least in part, of a composite elongate core 5 formed, at least in part, of precipitation hardened material. The elongate core members of the present invention will have an ultimate tensile strength and modulus of elasticity greater than the same for an identically dimensioned elongate member formed from superelastic NITINOL alone.

176180 v09.PA (3RXW09!.DOC)

10

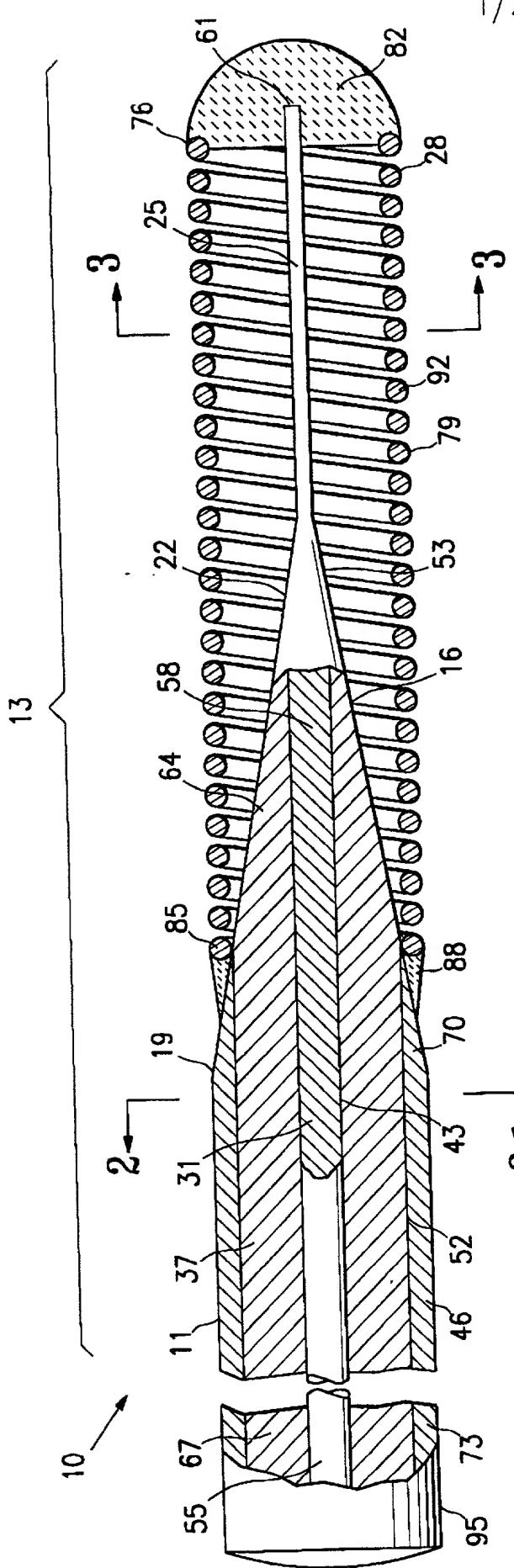


FIG. 1

1/2

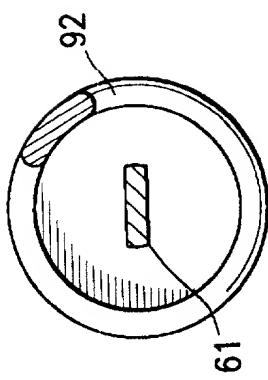


FIG. 2

FIG. 3

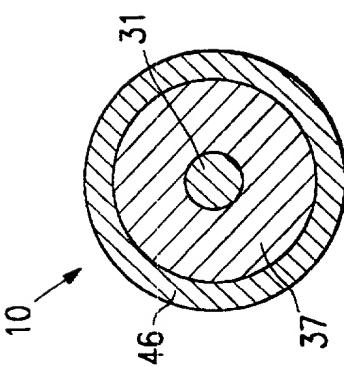


FIG. 5

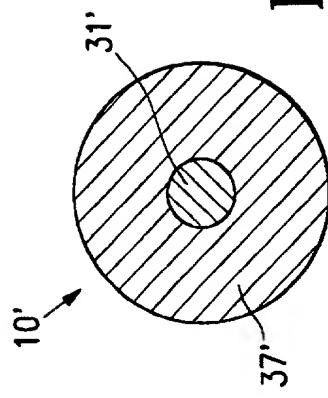


FIG. 6

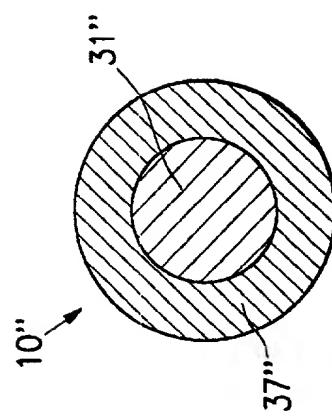
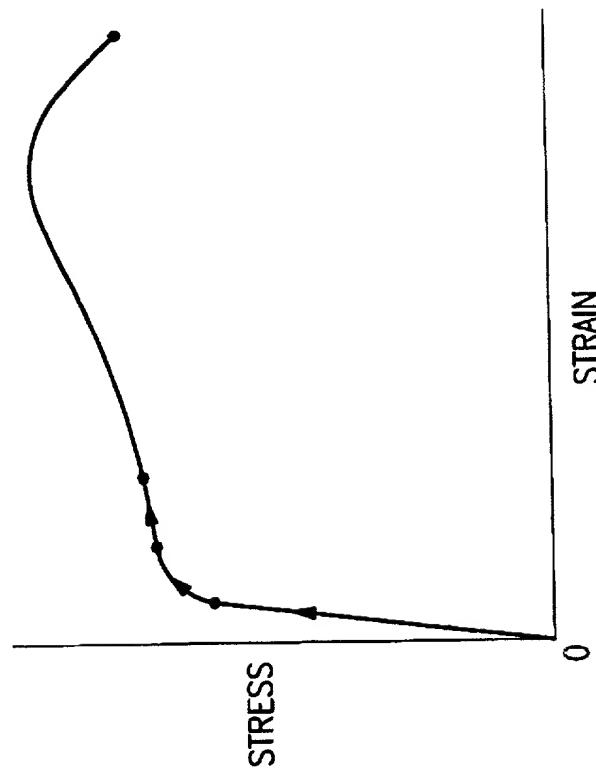


FIG. 4



Specimen 31' and 37' were cut from the same bar.

## **DECLARATION AND POWER OF ATTORNEY**

As the below named inventors, we hereby declare that:

Our residences, post office addresses and citizenships are as stated below next to our names.

We believe that we are the original, first and sole inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled **COMPOSITE GUIDEWIRE WITH DRAWN AND FILLED TUBE CONSTRUCTION**, the specification of which is attached hereto.

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

This application in part discloses and claims subject matter disclosed in our earlier filed pending application, Serial No. 09/224,453 which was filed on December 31, 1998.

We acknowledge the duty to disclose information which is material to the examination of this application and to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

We hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

NONE

We hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Application Serial No. 09/224,453 filed December 31, 1998

We hereby declare under penalty of perjury under the laws of the United States of America that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

We hereby appoint the following attorneys to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith:

EDWARD J. LYNCH, Registration No. 24,422  
JACQUES M. DULIN, Registration No. 24,067  
DEREK P. FREYBERG, Registration No. 29,250  
HERWIG von MORZE, Registration No. 29,484  
Y. PING CHOW, Registration No. 30,740  
WILLIAM SCHMONSEES, Registration No. 31,796  
WALTER KURZ, Registration No. 37,373  
ROBERT F. DENNIS, Registration No. 40,988  
WILLIAM B. ANDERSON, Registration No. 41,585  
PRISCILLA H. MARK, Registration No. 41,970  
VICTORIA L. BOYD, Registration No. 43,510  
ALICIA HAGER, Registration No. 44,140  
SOODABEH TRONSON, Registration No. 41,354  
COLENE E. HARTMAN BLANK, Registration No. 41,056  
KATHLEEN DAL BON, Registration No. 29,829  
of the firm  
HELLER EHRLICH WHITE & MC AULIFFE  
525 University Avenue  
Palo Alto, CA 94301-1900  
Telephone: (650) 324-7000  
and  
GEORGE M. COOPER, Registration No. 20,201  
ERIC S. SPECTOR, Registration No. 22,495  
FELIX J. D'AMBROSIO, Registration No. 25,721  
DOUGLAS R. HANSCOM, Registration No. 26,600  
JIM W. HELLWEGE, Registration No. 28,808  
WILLIAM A. BLAKE, Registration No. 30,548

COLIN D. BARNITZ, Registration No. 35,061

of the firm:

JONES, TULLAR & COOPER, P.C.  
2001 Jefferson Davis Highway  
Box 2266, EADS Station  
Arlington, VA 22202  
Telephone: (703) 415-1500

Direct all correspondence to:

**Edward J. Lynch**  
HELLER EHRLMAN WHITE & McAULIFFE  
**525 University Avenue**  
**Palo Alto, CA 94301-1900**  
**Tel. No.: (650) 324-7000**  
**Direct Dial: (650) 324-7098**  
**Facsimile: (650) 324-0638**

Full name of First and Joint Inventor: Marc Mehrzad Jalisi

Executed on \_\_\_\_ day of \_\_\_\_\_, 19 \_\_\_\_.

Inventor's Signature:

Residence:

30660 Milky Way Drive #J76  
Temecula, California 92592

Citizenship:

United States of America

Post Office Address:

same as above

Full name of Second and Joint Inventor: David M. Anderson

Executed on \_\_\_\_ day of \_\_\_\_\_, 19 \_\_\_\_.

Inventor's Signature:

Residence:

43086 Manchester Court  
Temecula, California 92592

Citizenship:

United States of America

Post Office Address:

same as above

Full name of Third and Joint Inventor: Wayne E. Cornish

Executed on \_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

Inventor's Signature:

Residence:

1650 Scooter Lane  
Fallbrook, California 92028

Citizenship:

Post Office Address:

United States of America  
same as above

Full name of Fourth and Joint Inventor: Nancy A. Nicotra

Executed on \_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

Inventor's Signature

Residence:

\_\_\_\_\_

Citizenship:

Post Office Address:

United States of America  
P.O. Box 892703  
Temecula, California 92589

Full name of Fifth and Joint Inventor: Mark T. Richardson

Executed on \_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

Inventor's Signature

Residence:

26050 Los Arboles Ranch Road  
Escondido, California 92026

Citizenship:

Post Office Address:

United States of America  
same as above